REMARKS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 11-16 are pending in the present application; no claims having been amended, canceled, or added by way of the present amendment.

In the outstanding Office Action, the specification was objected to because of trademark issues, Claims 11-16 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite, and Claims 11-16 were rejected under 35 U.S.C. § 102(b) as anticipated by or in the alternative under 35 U.S.C. § 103(a) as obvious over Hwang.

Applicants acknowledge with appreciation the courtesy of an interview extended by Examiner Hook to Applicants' attorney, during which the outstanding issues in the case were discussed. The detailed Interview Summary provided by Mr. Hook is greatly appreciated. However, no agreement was ultimately reached on the allowability of the claims.

The specification was objected to because of a failure to provide a complete description of two trademarks contained in the specification. In response to this objection and as discussed in the interview, the specification has been amended to include generic terminology for TEFLON. It was agreed at the interview that this is a well known term.

With respect to the added description of PROGUARD, the specification has been amended to recite a generic description of this material. This amendment is from publicly known material, and such material is included in the attached Appendix A. The first two pages of Appendix A generally show and describe centralisers and reference a ProGuard CRB Composite Properties Table. When clicking on that link on the first page of the Appendix, the second two pages of the Appendix are displayed in a web browser which describe in detail all of the properties of ProGuard CRB. The specification was amended on

page 12 to include the properties. It was agreed at the interview that adding these properties to the specification would not result in a new objection matter rejection.

Claims 11-16 stand rejected under 35 U.S.C. § 112, second paragraph. This rejection is respectfully traversed.

One aspect of the rejection was the indication in the specification that the carbon fibers were optional. While the specification discloses the carbon fibers as being optional, the claim recites such carbon fibers as an express element and they are not optional to the independent claim. It was agreed at the interview that as long as the Applicants argue that they intended to include both materials in Claim 11, then the record would be clear and the rejection would be withdrawn. Accordingly, Applicants make clear that the multiple materials include both a curable resin and ceramic particulate filler materials, these materials including chopped carbon fiber materials. Therefore, Claim 11 requires both a curable resin and ceramic particulate filler materials, those ceramic particulate filler materials including chopped carbon fiber materials.

Accordingly, the rejection under 35 U.S.C. § 112, second paragraph is respectfully requested to be withdrawn.

Claims 11-16 stand rejected under 35 U.S.C. § 102(b) as anticipated by, or in the alternative under 35 U.S.C. § 103(a) as obvious over Hwang. These rejections are respectfully traversed.

The present invention, as recited in Claim 11, for example, relates to a tubular body. This tubular body includes centralizer formations. These centralizer formations are formed as projections molded directly onto the tubular body from moldable materials comprising a curable resin, and ceramic particulate filler materials including chopped carbon fiber materials.

A specific feature of Claim 11 is the chopped carbon fiber materials. Carbon fiber is a high-strength material which provides advantages to the centralizer, including for example strength.

The outstanding Office Action at the bottom of page 4 and the top of page 5 acknowledges that Hwang discloses the use of antistatic fillers and it is considered old and well known in the art that carbon black fibers are used as antistatic fillers for pipe structures. Without addressing the merits of this argument, even if such materials were known and the combination could be made, the claim language is still not met. Carbon black fibers are completely different from carbon fibers. As shown in the attached Appendix B, carbon fiber includes carbon atoms which are bonded together in microscopic crystals that are more or less aligned parallel to the long axis of the fiber. The crystal alignment makes the fiber incredibly strong for its size. Contrary to carbon fibers, carbon black is a material produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, ethylene cracking tar, and a small amount from vegetable oil. It is similar to soot but with a much higher surface area to volume ratio. It is believed that carbon black fiber is simply carbon black in a fibrous form. However, carbon black and carbon black fibers are completely different from carbon fibers.

As the outstanding Office Action has not asserted that carbon fibers, as recited in the claims, are included or obvious in the system of Hwang and carbon black fibers are completely different from carbon fiber, the rejection under 35 U.S.C. §§ 102 and 103 should be withdrawn.

It is further noted that Hwang emphasizes that its devices is a damper and as described at the top of column 4, it is very important to Hwang to have viscoelastic properties and include products such as foams, urethane rubbers, silicone rubbers, nitrile rubbers, etc. It

is believed that it would not be obvious to add such a strengthening material such as carbon fiber to the system of Hwang.

The dependent claims are patentable for at least the reasons the independent claim from which they depend are patentable.

Consequently, in light of the above discussion and in view of the present amendment, the present application is in condition for formal allowance and an early and favorable action to that effect is requested.

Respectfully submitted,

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CARBON FIBER COMPOSITE CENTRALIZERS

PRODUCT IMAGES

Virtually any shape can be molded directly onto the pipe's outer diameter at the design engineer's specification (Reference the ProGuard CRB Composite Properties Table for technical specifications).

Fig. 1 - Spiral Blades in offset formation around pipe

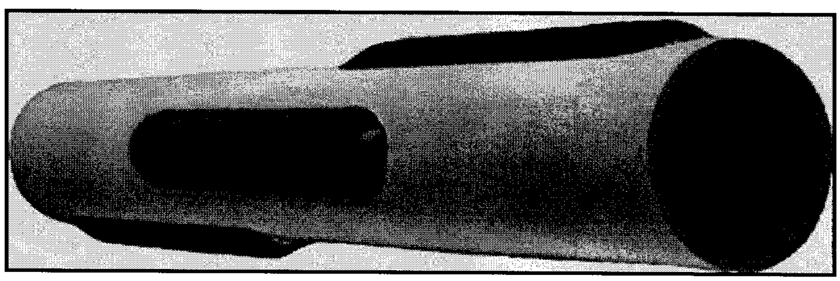


Fig. 2 - Staggered Straight Blade Centralizers

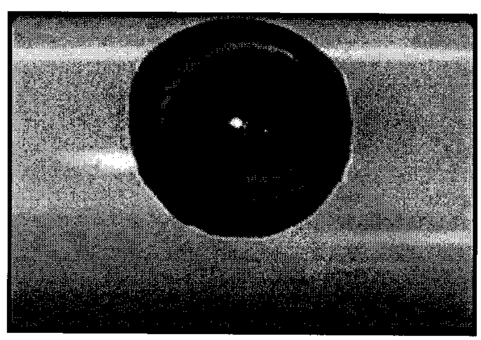
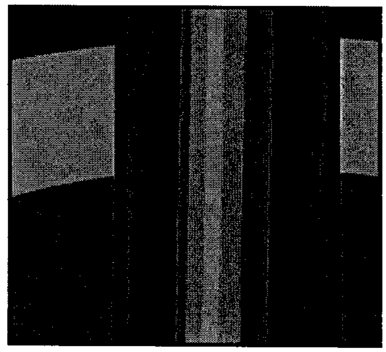


Fig. 3 - Button Centralizer (Low Friction)

A reliable application procedure has been developed so that the composite blades can be applied at any location according to your needs - be it rig site, pipe yard or warehouse. Such flexibility is vital when dealing with remote rig locations or severe weather.

VERSATILITY THROUGH DESIGN

The unique, beveled shape of Protech's centralizers allows the assembly easy passage into rocky, difficult holes. Rather than catching on rough spots as it is run into a well, the smooth shape of Protech's blades allows pipe to deflect and slip past protrusions inside the hole. Protech blades are not clustered in one area, but spaced all along the pipe for improved diversion. Please refer to the animation below for an example.



click to launch versatility animation

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THE DEVELOPMENT OF OUR CARBON FIBER CENTRALIZER TECHNOLOGY

COMPOSITE MATERIAL DEVELOPMENT

The target was to achieve the following mechanical properties with a bi-component ceramic-resin composite:

- High adhesion to the perpared substrate
- High wear resistance
- High compressive strength
- Good toughness
- Sufficient flexibility or modulus of elasticity
- Sufficient tensile and tensile shear strength
- Low coefficient of friction

In addition, the following requirements were desired:

- Ease of injection and workability
- Short cure time
- Low stress induced during the curing phase

A suitable combination of a bi-component amine cured epoxy resin compounded with a polyurethane hybrid (for flexibility), AL203 (Alumina), SIC (silicon carbide), TiN (titanium nitride) particulate and chopped carbon fiber, along with chemically binding the fillers to the resin system achieved the desired material properties. The following table is a summary of the material properties of the composite compounding that has achieved the best overall performance to date.

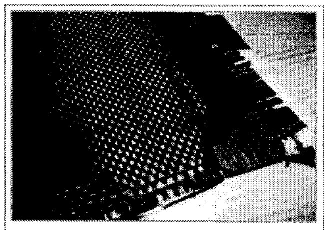
Direct Tensile Strength	ISO 527	38 Mpa (5,510 psi)
Compressive Strength	EN - 196 - 1	145 Mpa (21,025 psi)
Flexural Strength	ISO 178 - 93	116 Mpa (16,820 psi)
Impact Strength	ISO - 179 - 93	11 KJ/sq.m.
Specific Gravity (mixed material)	ISO 2811 - 1	1.675
Glass Transition Temperature		152°C following post cure
Surface Conductivity		10 10 - 10 12 ohms
Dialectic Strength	ASTM D149	>20 KV @ 1mm
Abrasion Resistance	Agip Test	6 mg
Static Coefficient of Friction		0.18
Hardness	Shore D	88
Shear Bond		28 Mpa (4,022 psi)

PROTECH CENTERFORM

Carbon fiber

From Wikipedia, the free encyclopedia

Carbon fiber or **carbon fibre**[1] (alternately called graphite fiber or graphite fibre) is a material consisting of extremely thin fibers about 0.0002–0.0004 inches (0.005–0.010 mm) in diameter and composed mostly of carbon atoms. The carbon atoms are bonded together in microscopic crystals that are more or less aligned parallel to the long axis of the fiber. The crystal alignment makes the fiber incredibly strong for its size. Several thousand carbon fibers are twisted together to form a yarn, which may be used by itself or woven into a fabric.[2] Carbon fiber can be combined with a plastic resin and wound or molded to form composite materials such as carbon fiber reinforced plastic (also referenced as carbon fiber) to provide a high strength-to-weight ratio material. The density of carbon fiber is also considerably lower than the density of steel, making it ideal for applications requiring low weight.[3] The properties of carbon fiber such as high tensile strength, low weight, and low thermal expansion make it very popular in aerospace, military, and motorsports, along with other competition sports.



Fabric made of woven carbon filaments

Contents

History of Carbon Fiber

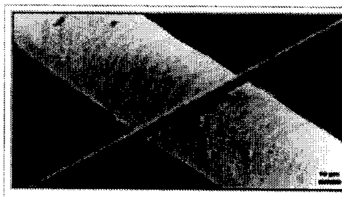
In 1957, Dr. Roger Bacon created the first high-performance carbon fibers at the Union Carbide Parma Technical Center, located outside of Cleveland, Ohio.[4]The first fibers were manufactured by heating strands of rayon until they carbonized. This process proved to be inefficient, as the resulting fibers contained only about 20% carbon and had low strength and stiffness properties. In the early 1960s, a process was developed using polyacrylonitrile (PAN) as a raw material. This had produced a carbon fiber that contained about 55% carbon and had much better properties. The polyacrylonitrile (PAN) conversion process quickly became the primary method for producing carbon fibers.[2]

On January 14, 1969 Carr Reinforcements (Stockport, England) wove the first ever carbon fiber fabric in the world.[5]

During the 1970s, experimental work to find alternative raw materials led to the introduction of carbon fibers made from a petroleum pitch derived from oil processing. These fibers contained about 85% carbon and had excellent flexural strength.[2]

Structure and properties

Carbon fibers are the closest to asbestos in a number of properties.[6] Each carbon filament thread is a bundle of many thousand carbon filaments. A single such filament is a thin tube with a diameter of 5–8 micrometers and consists almost exclusively of carbon.



A 6 μm diameter carbon filament (running from bottom left to top right) compared to a human hair.

The atomic structure of carbon fiber is similar to that of graphite, consisting of sheets of carbon atoms (graphene sheets) arranged in a regular hexagonal pattern. The difference lies in the way these sheets interlock. Graphite is a crystalline material in which the sheets are stacked parallel to one another in regular fashion. The chemical bonds between the sheets are relatively weak Van der Waals forces, giving graphite its soft and brittle characteristics. Depending upon the precursor to make the fiber, carbon fiber may be turbostratic or graphitic, or have a hybrid structure with both graphitic and turbostratic parts present. In turbostratic carbon fiber the sheets of carbon atoms are haphazardly folded, or crumpled, together. Carbon fibers derived from Polyacrylonitrile (PAN) are turbostratic, whereas carbon fibers derived from mesophase pitch are graphitic after heat treatment at temperatures exceeding 2200 C.

Turbostratic carbon fibers tend to have high tensile strength, wheresas heat-treated mesophase-pitch-derived carbon fibers have high Young's modulus and high thermal conductivity.

Applications

For common applications, see Carbon fiber reinforced polymer or CFRP.

Carbon Fiber Panoz DP01 Champ Car (right rear quarter).

Carbon fiber is most notably used to reinforce composite materials, particularly the class of materials known as Carbon fiber or graphite reinforced polymers. Non-polymer materials can also be used as the matrix for carbon fibers. Due to the formation of metal carbides (i.e., water-soluble AlC) and corrosion considerations, carbon has seen limited success in metal matrix composite applications. Reinforced carbon-carbon (RCC) consists of carbon fiber-reinforced graphite, and is used structurally in high-temperature applications. The fiber also finds use in filtration of high-temperature gases, as an electrode with high surface area and impeccable corrosion resistance, and as an anti-static component.

Carbon Fiber is used extensively in sailing boats, as a substitute to GRP or fiberglass hulls, or as a substitute to aluminium masts - this is because it is more flexible, stronger and far lighter. Monocoque hulls are often carbon fibre reinforced. It is also used in compressed gas tanks, including compressed air tanks. Other uses include Formula 1 racing vehicles, with the vehicle shell commonly composed of the material, often in combination with aramid and glass fibre. Carbon fibre is extensively used in the bicycle industry, especially for high-performance racing bikes. Carbon fiber is used in some tennis rackets. It is now being used in musical instruments for its weather resilience and ability to recreate the tone of guitars.

Synthesis

Each carbon filament is made out of long, thin filaments of carbon sometimes transformed to graphite. A common method of making carbon filaments is the oxidation and thermal pyrolysis of polyacrylonitrile (PAN), a polymer based on acrylonitrile used in the creation of synthetic materials. Like all polymers, polyacrylonitrile molecules are long chains, which are aligned in the process of drawing continuous filaments. A common method of manufacture involves heating the PAN to approximately 300 °C in air, which breaks many of the hydrogen bonds and oxidizes the material. The oxidized PAN is then placed into a furnace having an inert atmosphere of a gas such as argon, and heated to approximately 2000 °C, which induces graphitization of the material, changing the molecular bond structure. When heated in the correct conditions, these chains bond side-to-side (ladder polymers), forming narrow graphene sheets which eventually merge to form a single, jelly roll-shaped or round filament. The result is usually 93–95% carbon. Lower-quality fiber can be manufactured using pitch or rayon as the precursor instead of PAN. The carbon can become further enhanced, as high modulus, or high strength carbon, by heat treatment processes. Carbon heated in the range of 1500-2000 °C (carbonization) exhibits the highest tensile strength (820,000 psi or 5,650 MPa or 5,650 N/mm^2), while carbon fiber heated from 2500 to 3000 °C (graphitizing) exhibits a higher modulus of elasticity (77,000,000 psi or 531 GPa or 531 kN/mm^2).

Textile

There are several categories of carbon fibers: standard modulus (250 GPa), intermediate modulus (300 GPa), and high modulus (> 300 GPa).[7] The tensile strength of different yarn types varies between 2000 and 7000 MPa. A typical density of carbon fiber is 1750 kg/m^3.

Precursors for carbon fibers are PAN, rayon and pitch. Carbon fiber filament yarns are used in several processing techniques: the direct uses are for prepregging, filament winding, pultrusion, weaving, braiding etc. Carbon fiber yarn is rated by the linear density (weight per unit length = 1 g/1000 m = tex) or by number of filaments per yarn count, in thousands. For example, 200 tex for 3,000 filaments of carbon fiber is three times as strong as 1,000 carbon fibers but is also three times as heavy. This thread can then be used to weave a carbon fiber filament fabric or cloth. The appearance of this fabric generally depends on the linear density of the yarn and the weave chosen. Some commonly used types of weave are twill, satin and plain.

Manufacturers

PAN aerospace/high end carbon fiber:

- Toray Industries (largest worldwide manufacturer)
- Toho Tenax

- Mitsubishi
- Hexcel
- Cytec Industries
- Schunk Gruppe

PAN commercial grade carbon fiber:

- Zoltek
- SGL
- Fortafil

Pitch carbon fiber:

- Sumitomo

See also

- Carbon nanotube

Notes

1. ^ See American and British English spelling differences.
2. ^ *a b c* carbon fiber: Definition and Much More from Answers.com
3. ^ Mr. Jeremy Hierholzer, Assistant Professor of Aviation Technology, Purdue University, 2007.
4. ^ Bacon's breakthrough
5. ^ "Carr Reinforcements". Retrieved on 2008-06-01.
6. ^ Properties And Fiber Types
7. ^ "Carbon Fiber Data Sheets - Continuous Fiber", *Hexcel Corporation*, 26 November 2007.

External links

- Bacon's breakthrough at ACS.org
- Carbon Fiber at ps
- The Chemistry of Carbon Fiber
- Making Carbon Fiber

Carbon black

From Wikipedia, the free encyclopedia

Carbon black is a material produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, ethylene cracking tar, and a small amount from vegetable oil. Carbon black is a form of amorphous carbon that has a high surface area to volume ratio, and as such it is one of the first nanomaterials to find common use, although its surface area to volume ratio is low compared to activated carbon. It is similar to soot but with a much higher surface area to volume ratio. Carbon black is used as a pigment and reinforcement in rubber and plastic products.

The current International Agency for Research on Cancer (IARC) evaluation is that, "Carbon black is possibly carcinogenic to humans (Group 2B)". Short-term exposure to high concentrations of carbon black dust may produce discomfort to the upper respiratory tract, through mechanical irritation.

Contents

Common uses

The most common use [70%] of carbon black is as a pigment and reinforcing phase in automobile tires. Carbon black also helps conduct heat away from the tread and belt area of the [tire, reducing thermal damage and increasing tire life. Carbon black particles are also employed in some radar absorbent materials and in printer toner.

Total production is about 8.1 million tonnes (2006)[1]. About 20% of world production goes into belts, hoses, and other rubber goods. The balance is used in inks and as a pigment for products other than tires.

Carbon black from vegetable origin is used as a food coloring, in Europe known as additive **E153**.

Reinforcing carbon blacks

The highest volume use of carbon black is as a reinforcing filler in rubber products, especially tires. While a pure gum vulcanizate of styrene-butadiene has a tensile strength of no more than 2.5 MPa, and almost nonexistent abrasion resistance, compounding it with 50% of its weight of carbon black improves its tensile strength and wear resistance as shown in the below table.

Types of carbon black used in tires

Name	Abbrev.	ASTM Desig.	Particle Size nm	Tensile Strength MPa	Relative Laboratory Abrasion	Relative Roadwear Abrasion
Super Abrasion Furnace	SAF	N110	20-25	25.2	1.35	1.25
Intermediate SAF	ISAF	N220	24-33	23.1	1.25	1.15
High Abrasion Furnace	HAF	N330	28-36	22.4	1.00	1.00
Easy Processing Channel	EPC	N300	30-35	21.7	0.80	0.90
Fast Extruding Furnace	FEF	N550	39-55	18.2	0.64	0.72
High Modulus Furnace	HMF	N683	49-73	16.1	0.56	0.66
Semi-Reinforcing Furnace	SRF	N770	70-96	14.7	0.48	0.60
Fine Thermal	FT	N880	180-200	12.6	0.22	--
Medium Thermal	MT	N990	250-350	9.8	0.18	--

Practically all rubber products where tensile and abrasion wear properties are crucial use carbon black, so they are black in color. Where physical properties are important but colors other than black are desired, such as white tennis shoes, precipitated or fused silica is a decent competitor to carbon black in reinforcing ability. Silica-based fillers are also gaining market share in automotive tires because they provide better trade-off for fuel efficiency and wet handling due to a lower rolling loss compared to carbon black-filled tires. Traditionally silica fillers had worse abrasion wear properties, but the technology has gradually improved to where they can match carbon black abrasion performance.

Pigment

Carbon black (Colour Index International, PBL-7) is the name of a common black pigment, traditionally produced from charring organic materials such as wood or bone. It consists of pure elemental carbon, and it appears black because it reflects almost no light in the visible part of the spectrum. It is known by a variety of names, each of which reflects a traditional method for producing carbon black:

- Ivory black was traditionally produced by charring ivory or bones (see bone char).
- Vine black was traditionally produced by charring desiccated grape vines and stems.
- **Lamp black** was traditionally produced by collecting soot, also known as lampblack, from oil lamps.

Newer methods of producing carbon black have superseded these traditional sources, although some materials are still produced using traditional methods, for artisanal purposes.it is very use full.

Surface chemistry

All carbon blacks have chemisorbed oxygen complexes (i.e., carboxylic, quinonic, lactonic, phenolic groups and others) on their surfaces to varying degrees depending on the conditions of manufacture. These surface oxygen groups are collectively referred to as volatile content. It is also known to be a non-conductive material due to its volatile content.

The coatings and inks industries prefer grades of carbon black that are acid oxidized. Acid is sprayed in high temperature dryers during the manufacturing process to change the inherent surface chemistry of the black. The amount of chemically-bonded oxygen on the surface area of the black is increased to enhance performance characteristics.

See also

- Activated carbon

References

- Doerner, Max. *The Materials of the Artist and Their Use in Painting: With Notes on the Techniques of the Old Masters*, Revised Edition. Harcourt (1984). ISBN 0-15-657716-X. This is a contemporary English language edition of a work originally published in German.
- Meyer, Ralph. *The Artist's Handbook of Materials and Techniques*. Fifth Edition, Revised and Updated. Viking (1991) ISBN 0-670-83701-6
- Carbon Black: A users guide. Published by the International Carbon Black Assosciation.

External links

- International Chemical Safety Card 0471
- Carbon black - *NIOSH Pocket Guide to Chemical Hazards*, CDC Website Entry
- Carbon Black Industry from the Handbook of Texas Online
- carbon-black.org-International Carbon Black Association